

# INTRODUCTION TO HYDROGEN PEROXIDE

## physical and chemical properties of hydrogen peroxide

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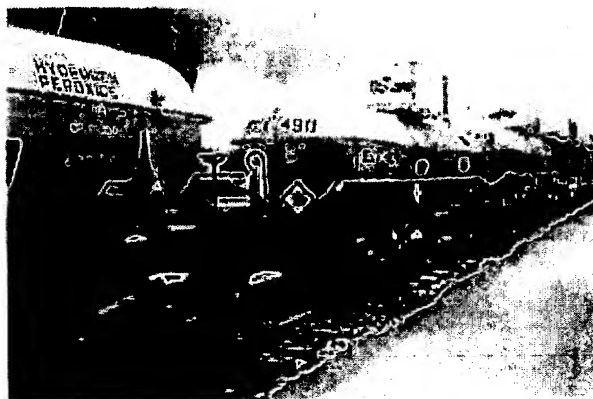
#### ► Summary

#### ► Physical Properties

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Exh. 6. + A

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► **Solubility Properties**

Solubility / Distribution coefficients in selected solvents

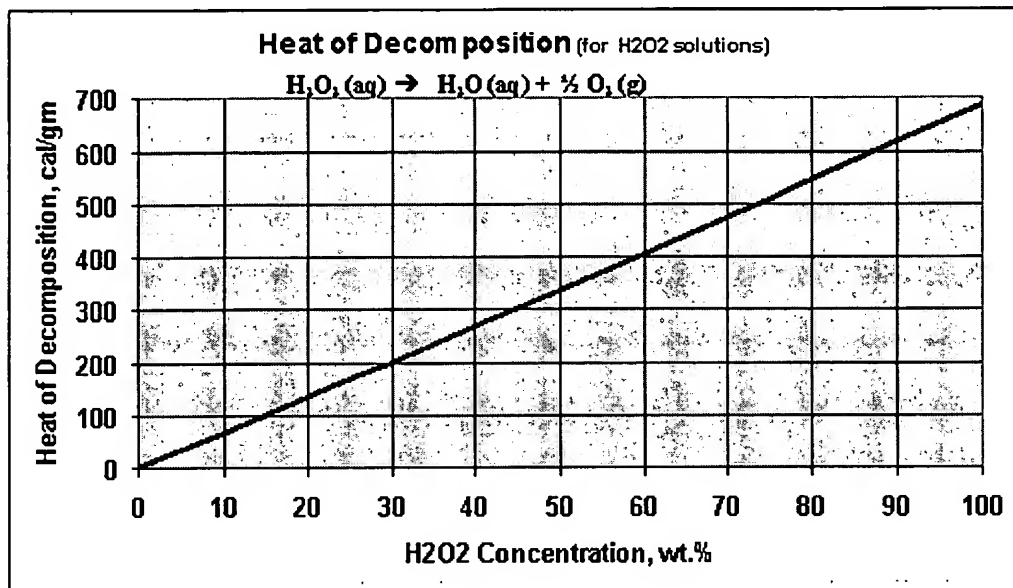
1. Alkanes
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3. Ethers
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[\*\*\[To Frequently Asked Questions \(FAQ\)\]\*\*](#)

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## 5. Heat of decomposition

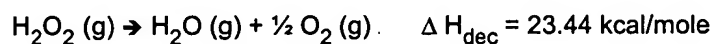


P.A. Giguere, *Complements au Nouveau Traite de Chemie Minerale – No. 4 Peroxyde d'Hydrogene et Polyoxydes d'Hydrogene*, Paris, Mason, p.181 (1975)

### NOTES:

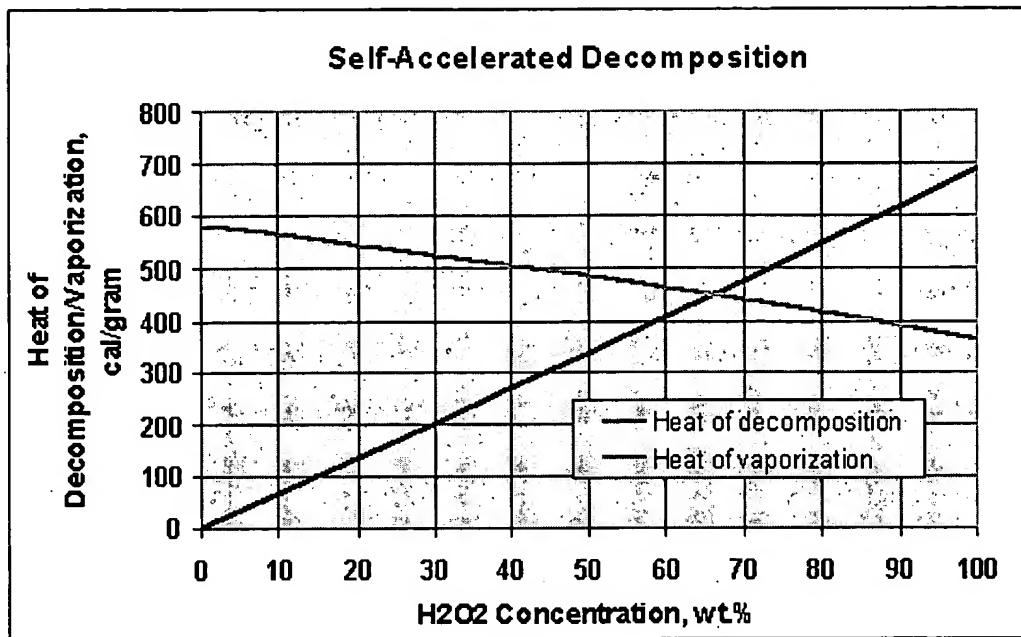
1. The standard free energy change ( $\Delta F^\circ$ ) is -27.92 kcal/mole at 25 °C
2. Rapid decomposition of concentrated H<sub>2</sub>O<sub>2</sub> solutions may not be complete, with concentrations up to 10% remaining.

## 6. Heat, Free Energy, and Equilibrium Constant



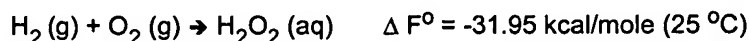
W.C. Schumb, C.N. Satterfield, R.L. Wentworth. *Hydrogen Peroxide*, ACS Monograph, Reinhold Publishing, pg. 251 (1955).

## 7. Decomposition products



- NOTES:**
1. H<sub>2</sub>O<sub>2</sub> decomposition is highly exothermic (23.44 kcal/mole). Even 10% H<sub>2</sub>O<sub>2</sub> can boil if it becomes grossly contaminated.
  2. The effect of temperature is such that an increase of 10 °C increases the rate of decomposition by a factor of 2.3 (i.e., a first order rate equation). Therefore, decomposition can accelerate if the solution becomes grossly contaminated.
  3. As the concentration of H<sub>2</sub>O<sub>2</sub> in solution increases, there is less water to absorb the heat of decomposition. A crossover occurs at 63-64% H<sub>2</sub>O<sub>2</sub> where rapid, accelerated decomposition becomes self-sustaining and the concentration of H<sub>2</sub>O<sub>2</sub> in the decomposing solution can actually increase.

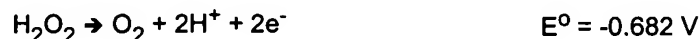
#### 10. Free energy of formation



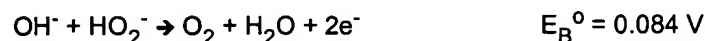
Temp., °K	ΔH, kcal/mole	ΔF, kcal/mole	log K
0	-31.26	-31.26	---
298	-32.52	-25.24	18.51
300	-32.54	-25.20	18.35
400	-32.80	-22.71	12.41
500	-33.01	-20.16	8.81
600	-33.15	-17.58	6.40
700	-33.30	-14.98	4.68
800	-33.38	-12.36	3.38
900	-33.48	-9.73	2.36
1000	-33.56	-7.08	1.55
1100	-33.63	-4.43	0.88
1200	-33.69	-1.83	0.33
1300	-33.73	0.92	-0.15
1400	-33.77	3.56	-0.56
1500	-33.79	6.24	-0.91

## 11. Standard electrode potentials

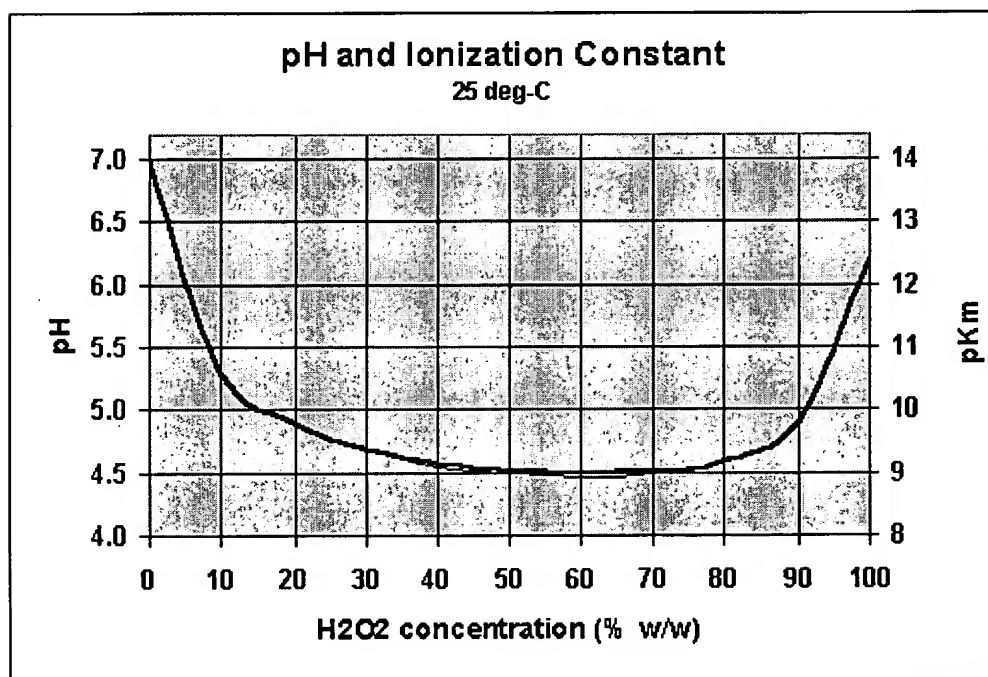
$\text{H}_2\text{O}_2$  contains oxygen in a state of oxidation midway between molecular oxygen and water.



For perhydroxyl ion ( $\text{HO}_2^-$ ):



## 12. pH and Ionization Constant



## 13. Dissociation: Heat, Free Energy, and Equilibrium Constant

	$\Delta H^\circ$	$\Delta F^\circ$ (kcal/mole)
<u>Nonionic</u>		
$\text{H}_2\text{O}_2(\text{g}) = \text{H}_2\text{O}(\text{g}) + \text{O}(\text{g})$	+ 33.90	+ 25.60
	+ 136.72	+ 122.41